CHARACTERIZATION OF UTAH'S NATURAL GAS RESERVOIRS AND POTENTIAL NEW RESERVES

INTRODUCTION

The U.S. Energy Information Administration projects the demand for natural gas in this country will grow at an average annual rate of 2 percent per year for the next 20 years. Utah will play a vital role, along with other Rocky Mountain states, in meeting that demand. The Rocky Mountain Region now provides 20 percent of our nation's natural gas according to the University of Utah Bureau of Economic Research. The U.S. Geological Survey calculates there is 14 to 26 trillion cubic feet (TCF) of nonassociated undiscovered gas in the Uinta Basin (USGS, 2002) and 0.3 to 1.1 TCF of nonassociated undiscovered gas in the Paradox Basin (USGS, 1996). The National Research Council of the National Academies acknowledges that there exists a large amount of uncertainty associated with supply and demand of natural gas including resource estimates. To maximize Utah's natural gas potential, the Utah Geological Survey is beginning a multi-year geologic assessment of the state's natural gas resource to more fully understand the resource base and to encourage exploration for new gas reserves.

Utah has produced natural gas since 1891, but low prices, a lack of a national market for Rocky Mountain gas, and expensive drilling, have resulted in slow development of the state's natural gas resource. The 21st Century has brought dramatic changes to Utah and other Rocky Mountain gas-producing states with a major shift to use of cleaner burning natural gas in industrial and electric generation. As a result, there has been a significant increase in demand for natural gas and an associated increase in price. New pipelines have been constructed to transport the Rocky Mountain gas out of the region, which have brought more competitive national pricing to Utah's natural gas. Drilling and production from under-developed gas plays and exploration for new plays, both conventional and unconventional, will result in a significant financial contribution to Utah's economy for many decades to come. The Utah Bureau of Economic and Business Research reported that nearly 140 million dollars in royalties and severance tax was paid on Utah's natural gas production in 2001.

BACKGROUND

The majority of Utah's natural gas reserves and future potential is in the Uinta Basin, northeastern Utah; lesser reserves are also found in the Paradox Basin in southeastern Utah (figures 1 and 2). Both basins have historically been significant exploration areas for oil but also contain abundant reserves of natural gas. The natural gas plays in the Uinta Basin are: (1) Tertiary Uinta Formation, (2) Tertiary Wasatch (Colton) and Tertiary-Cretaceous North Horn Formations, (3) Cretaceous Mesaverde Group, (4) Cretaceous Mesaverde Group coalbed methane, (5) Cretaceous Mancos Shale, (6) Cretaceous Ferron Sandstone coalbed methane, (7) Cretaceous Dakota, Cedar Mountain, and Jurassic Morrison Formations, and (8) Jurassic Entrada, Navajo, Kayenta, and Wingate Sandstones.

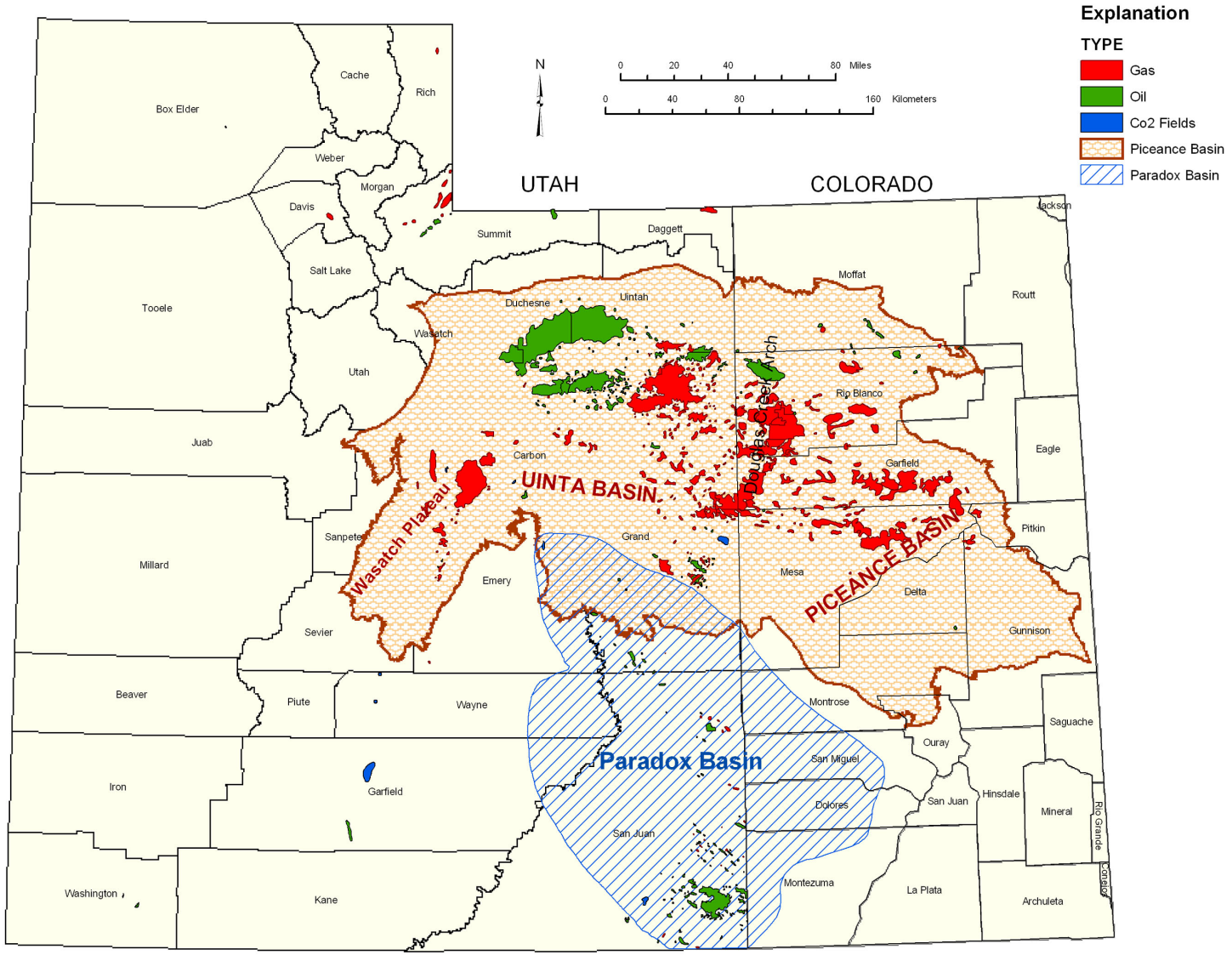
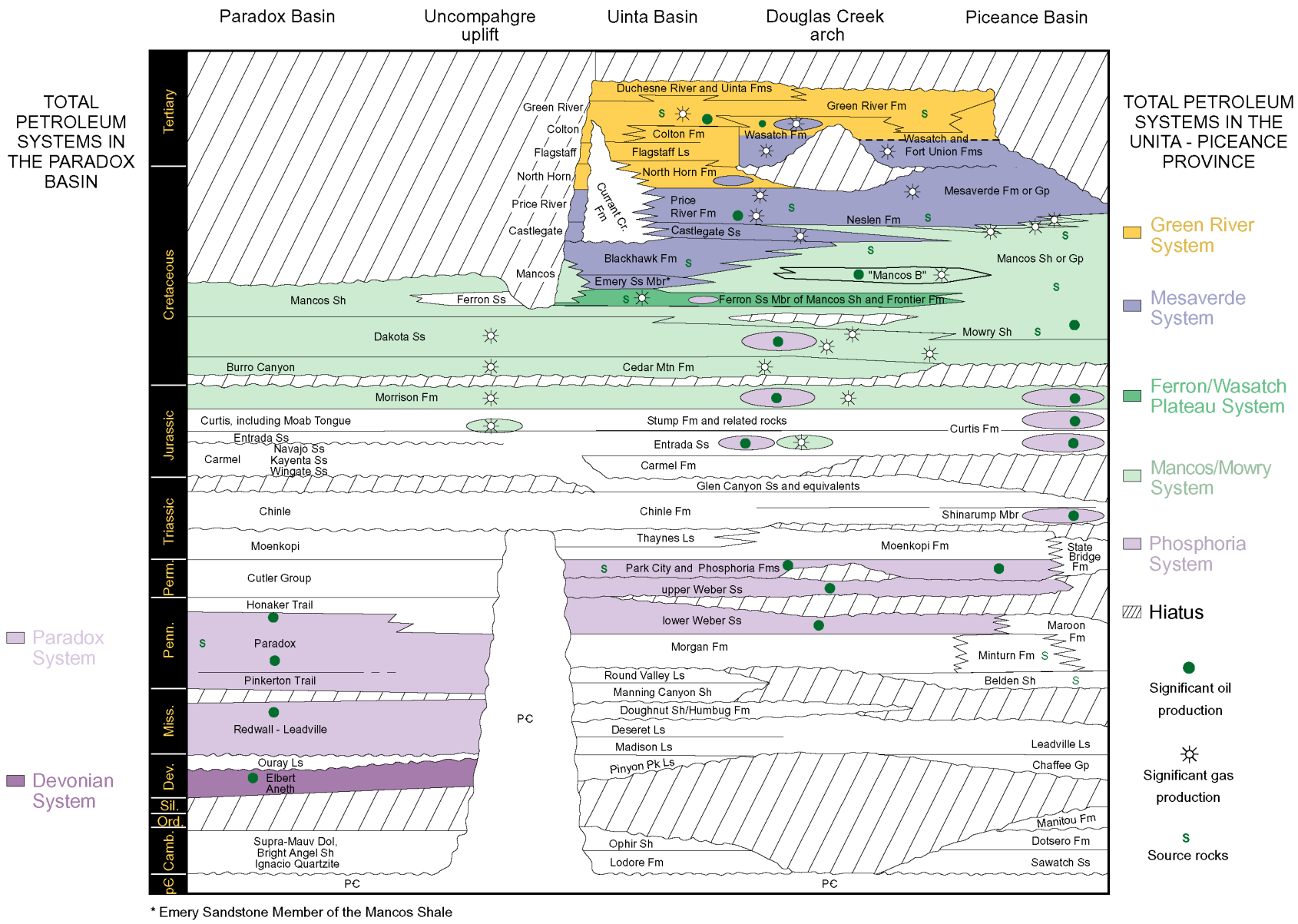


Figure 1. Map showing the Uinta and Piceance Basins separated by the Douglas Creek arch, and the Paradox Basin, eastern Utah and western Colorado. The Paradox Basin formed in the Pennsylvanian and the Uinta Basin formed in the late Cretaceous. The have a small area of overlay. Gas fields are in red and oil fields are in green.



* Emery Sandstone Member of the Mancos Shale

Figure 2. Generalized stratigraphic column of the Uinta, Piceance, and Paradox Basins showing the distribution of petroleum system source rocks and reservoirs (modified from the USGS, 2002).

The natural gas plays in the Paradox Basin are: (1) Permian Cutler and Pennsylvanian Honaker Trail Formations, and (2) Pennsylvanian Paradox Formation fractured shale. In addition, a hypothetical natural gas play exists in the Basin and Range Province: the Quaternary and Tertiary, shallow, biogenic gas play.

KEY FACTORS OF UTAH'S GAS PLAYS

Uinta Basin Plays

Tertiary Uinta Formation Play

- Shallow drilling depths in the play area
- Under explored, not a primary target
- Numerous penetrations for underlying objectives
- Tar may reduce permeability
- Limited play area
- Much of the acreage is held by a few operators
- Not actively being pursued by operators, so good geologic assessment work has the potential to attract increased interest

Tertiary Wasatch (Colton) and Tertiary-Cretaceous North Horn Formation Play

- Moderate drilling depths in most of the play area
- Proven to be a major producer in the Greater Natural Buttes field
- Multiple, stacked, channel reservoirs
- Continuous, deep-basin gas potential exists
- Classified as tight gas sand play (< 0.1 md)
- Cap faulting and fracturing necessary for migration from underlying source beds
- Geological assessment could result in a large increase in the total gas reserves

Cretaceous Mesaverde Group Play

- Large undiscovered gas potential, 8.5 to 14.4 TCFG
- Actively being drilled in the Great Natural Buttes and Wonsits Valley fields
- Multiple reservoirs and in-situ source rocks
- Continuous, deep-basin gas potential could be very large
- Classified as tight gas sand play (< 0.1 md)
- Geological assessment could result in a large increase in the total gas reserves

Cretaceous Mesaverde Group Coalbed Methane Play

- Significant development and exploration potential
- Most coal trends are easily defined

- Blackhawk coals are gassy, but low gas permeability and possible oil blockage inhibit productivity
- Neslen coals' methane content and cleating poorly characterized
- Good potential for deeper coalbed methane

Cretaceous Mancos Shale Play

- Significant producer in Colorado's Piceance Basin, but relatively untested in Utah's Uinta Basin
- Penetrations by wells exploring underlying reservoirs are concentrated in the southern portion of the Uinta Basin
- High-risk play, but would generate large interest if geologic resource assessment identifies good potential

Cretaceous Ferron Sandstone Coalbed Methane Play

- Southern half of play sparsely drilled, but may be undersaturated
- Reasons for areas of higher productivity poorly understood
- Secondary recovery potential exists

Cretaceous Dakota, Cedar Mountain, and Jurassic Morrison Play

- Undiscovered potential of 2.9 to 4.9 TCFG (Uinta and Piceance Basins combined)
- Multiple reservoir objectives are present in both structural and stratigraphic traps
- Much of the play area is under explored except in the southern portion of the basin
- May have continuous, deep-basin gas potential
- New 3-D seismic has greatly improved the ability to identify channel deposit reservoirs
- Much of the area is classified as a tight gas sand play (0.1 md)
- Some areas have low-Btu gas with high levels of carbon dioxide and nitrogen
- Geologic assessment showing broader potential would create strong interest in areas outside establish fields

Jurassic Entrada, Navajo, Kayenta, and Wingate Sandstones Play

- Thick, high-permeability reservoir rocks exist
- Relatively unexplored throughout most of the Uinta Basin
- Recent 3-D seismic has proven successful in identifying traps in subtle structures and paleodepositional highs
- Continuous, deep-basin gas potential exists
- Some areas have low-Btu gas with high levels of carbon dioxide and nitrogen
- Limited data show significant loss of porosity with depth
- Recent new discoveries have raised the interest level, and geologic assessment would promote significant interest

Paradox Basin Plays

Permian Cutler and Pennsylvanian Honaker Trail Formations Play

- Unexplored play with only one field in Utah and high upside potential
- Abundant reservoir rock exists
- Source migration pathways and traps for gas poorly understood
- Potential may be limited to westernmost portion of the Paradox Basin
- Some recent interest shown; but interest could be greatly increased if geologic resource assessment defines good potential

Pennsylvanian Paradox Formation Fractured Shale Play

- Hypothetical gas play, typically an oil play objective
- Organic-rich shale beds have excellent source potential for hydrocarbons
- Numerous penetrations by wells exploring deeper reservoirs
- Gas potential may be limited to westernmost portion of the Paradox Basin
- Proper geologic assessment showing good potential could attract much interest

Basin and Range Province Play

Quaternary and Tertiary Shallow Biogenic Gas Play

- Unconventional and highly speculative play
- Abundant source beds in close proximity to reservoir beds
- Very shallow inexpensive drilling
- Numerous water well penetrations provide control
- Play limited to deltas of the Great Salt Lake and flood plains of the Bear River
- Significant wildlife and wetlands issues
- Economics are unproven, the play may require developing markets near the gas fields for business, industry, and small electric generators

REFERENCES

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